DIETARY AND BEHAVIORAL PREDICTION OF OBESITY IN THE NAVY

Barbara C. Du Bois, Ph.D.

Jerry D. Goodman, Ph.D.

Terry L. Conway, Ph.D.

Health Services Research Department
Naval Health Research Center
P.O. Box 85122
San Diego, CA 92186-5122

Report 89-56, was supported by the Naval Medical Research and Development Command, Department of the Navy under Program Element No. 61152N. MR0001, and by the Naval Military Personnel Command, work order number N0002289WRWW542. The views expressed are those of the authors and do not reflect the official policy or position of the Department of the Navy, Department of Defense, or the U.S. government.

Summary

Problem

During 1987 and 1988, the prevalence of "overfat" personnel in the U.S. Navy was about 6%, while the prevalence of morbid obesity (26% or more body fat in males and 36% or greater body fat in females) was 4%. Although the proportion of Navy personnel who are obese is somewhat lower than in the general population, the current Navy rates still pose concerns for the health and physical readiness of personnel.

Objective

The overall purpose of the present study was to examine the factors related to obesity in the Navy. Specific objectives were to determine the role of diet and the relationship of obesity-prone behaviors while controlling for the effects of sex and age.

Approach

The sample (N=153) consisted of lean and overweight personnel. Overweight subjects were enrolled in one of two Navy weight reduction programs, while lean subjects were contacted through the Navy's annual dental exam.

Results

Demographic results for study participants indicated that obesity was more common among women than men, and personnel of older than younger age. Dietary results indicated that overweight males consumed significantly fewer calories and less carbohydrate than lean males; however, non-significant trends showed that overfat males consumed more cholesterol and sucrose than normal weight males. Overfat females ate significantly more fat, cholesterol, saturated fat, and sodium than normal weight females. For the sample as a whole, carbohydrate intake was negatively related to percent body fat, such that those of heaviest weight were less likely to eat carbohydrates than those of normal weight. Although behavioral factors indicated that the overweight were more inclined toward food obsessions and emotional eating, the highest proportion of explained variance in obesity was demonstrated by the interaction of food obsessions with older age. Food obsessions present more of a problem in terms of increasing percent body fat with older age.

Conclusions

Navy weight reduction treatment programs should target specific eating behaviors to increase the amount of carbohydrate in the diets of overweight personnel, reduce the intake of high fat food, and make psychological counseling available for out-patient programs, because the obese tend to exhibit a higher frequency of eating behaviors arising from emotional or effective states than nonobese.

INTRODUCTION

The proportions of Americans who are overweight and obese have been steadily increasing. In 1988, it was estimated that roughly 1 in 4 adults was overweight (Greenwood & Pittman-Waller, 1988). In 1986, a Department of Health and Human Services report indicated that 20-30% of males and 25-40% of females over the age of 35 are overweight (U.S. Department of Health and Human Services and Agriculture, 1986). In the 1985 Health Interview Survey, 23.5% of adult males and 24.2% of adult females were self-reported as overweight (Stephenson, Levy, Sass and McGarvey, 1987). The best estimates of the overweight population are from the National Health and Nutrition Examination Surveys (NHANES) which used assessments of height and weight to determine body mass[2]. The NHANES-II survey, conducted between 1976 and 1980, determined the prevalence of overweight American adults was 24.2% among males and 27.1% among females (Najjar and Rowland, 1987). Approximately 34 million adult Americans were classified as 20% or more above ideal weight. Of this group, over one third (35%) were classified as severely obese (Van Itallie, 1985). These figures show a dramatic increase in the overweight population since NHANES-I, conducted between 1971 and 1974, in which 29 million Americans between the ages of 20 and 74 were obese, while 8.4% were classified as severely obese (Braitman, Adlin, & Stanton, 1985; National Center for Health Statistics, 1983).

Severely overweight people have greater morbidity and mortality risks from coronary artery disease, cancer, diabetes, as well as conditions related to obesity (Bray 1987; Greenwood & Pittman-Waller, 1988; Leads from the Morbidity and Mortality Weekly Reports, 1988; Mann, 1974; Simopoulos, 1986; Van Itallie, 1979; U.S. Public Health Service, 1988). The relative risks associated with being obese increase with increased excess weight (Van Itallie, 1979). Estimates from the NHANES data revealed that overweight adults have a relative risk for hypertension 3 times that of normal weight individuals (Van Itallie, 1985). Overweight persons are 3 times as likely to be afflicted with diabetes than normal weight people and are 1.5 times as likely to suffer from hypercholesterolemia as non-overweight people[3]. Weight reduction commonly reduces these risks to normal levels.

Dietary and Behavioral Correlates of Obesity

Obesity is the result of body-weight regulation in response to energy intake and energy expenditure (Garrow, 1987). When energy intake exceeds energy expenditure, weight gain occurs. Although the basic mechanism appears quite simple, obesity is a complex condition which is influenced by a variety of factors whose importance varies from person to person.

Dietary Intake. Americans consume approximately 40% of their total calories from protein sources (i.e. meat, poultry, and fish), 40% from fat, and around 20% from carbohydrate sources (Howard and Herbold, 1978). The proportion of fat in the diet has increased from 30 to 40% of total calories in the last 70 years (Harper, 1987). Excess calories (not expended for normal body functioning or burned through exercise) are stored as potential energy or fat (McArdle and Toner, 1988). Although there is mounting evidence that the obese do not necessarily consume more calories than the nonobese (Braitman, Adlin, & Stanton, 1985; Raymond, 1988; Thompson, Jarvie, & Lahey, 1982), studies have indicated there are higher levels of plasma lipids, saturated fatty acids, triglycerides, and cholesterol in obese than less obese subjects (Berry, Hirsch, Most, & Thornton, 1986; Davidson, Passmore, Brock & Truswell, 1979). Additionally, higher intakes of carbohydrates and polyunsaturated fats were shown to be inversely related to obesity (Berry et al., 1986). In terms of nutritional preferences and dietary composition, there is some evidence that the obese prefer fats to sweets, which could account for the higher rates of plasma lipids (Gonzalez, 1983). Although there is no evidence that sodium alone results in obesity, excess body weight is partly attributable to water retention associated with sodium intake.

Behavioral Factors. Much of the psychological research conducted on eating behaviors and disorders associated with obesity has focused upon external cue sensitivity/responsiveness and personality characteristics of the obese person (Leon and Roth, 1977; Lowe and Fisher, 1982). The notion that the obese respond to external cues that trigger eating more commonly than the nonobese receives wide currency and serves as the basis for a variety of treatment modalities (Brownell, 1982; Stuart, 1980). External cues may serve as stimuli for a wide range of eating behaviors. In intervention design, subjects learn to control their responsiveness to food cues by adopting alternative behaviors to eating. Weight loss programs utilizing behavior change instruction show more promising long-term results

when combined with comprehensive treatment that includes social support mobilization and exercise (Brownell, 1982).

Although controversial, some studies have found that obese individuals are more emotionally reactive and more prone to emotionally-induced snacking episodes with higher weight elevations (Lowe and Fisher, 1982). Obesity-related eating disorders (e.g. food bingeing, purging, and/or "bulimia") have been associated with certain dysfunctional behaviors. Among these are borderline personality disorder (Johnson, Tobin, and Enright, 1989), anxiety or depression (Hoiberg, Berard, & Watten, 1978; Keck & Fiebert, 1986), the perception of little self-control (Loro & Orleans, 1981; Wilson, 1976), impulsiveness, obsessive behavior, or guilt (Williamson, Kelley, Davis, Ruggiero, & Blouin, 1985), difficulty coping with stress (Loro & Orleans, 1981), and interpersonal difficulties in general (Kolotkin, Revis, Kirkley & Janick, 1987). Dysfunctional behaviors occur in the nonobese; however, these studies show they are more common in the obese. It should also be noted that dysfunctional eating behaviors may be episodic rather than typical patterns of eating. Although the evidence indicates that the obese typically consume approximately the same amount of calories as the nonobese, they may intermittently consume a higher level during periods of behavioral dysfunction. That the obese appear more responsive to taste than the nonobese (Hashim & Van Itallie, 1965) and show tendencies with more problems with body image distortion are commonly reported findings (Stunkard & Burt, 1967; Wright & Whitehead, 1987). Obese subjects also tend to prefer some foods commonly held to be of low nutritional value, whereas the nonobese tend to select foods that are more commonly perceived as nutritious (Drewnowski, 1985).

Exercise. Although some studies have shown equivocal results in activity levels between the obese and nonobese, reduced physical activity tends to occur more commonly among the obese (Lincoln, 1972; Pi-Sunyer, 1988). In the absence of reduced caloric intake, exercise is generally insufficient for weight reduction. Moderate to vigorous physical activity, however, appears to make its greatest impact on those whose body mass classifies them as obese (BMI>30) (Pacy, Webster, & Garrow, 1986). Although sustained exercise will raise resting metabolic rate (Thompson, Jarvie, Lahey, & Cureton, 1982), there is insufficient evidence that increasing exercise will prevent obesity (Pi-Sunyer, 1988; Thompson, et al., 1982).

Study Objectives

Recently, the Navy promulgated instructions outlining acceptable standards of obesity and overfatness for Navy personnel (OPNAV 6110.1C [7 Aug 86]). Navy-wide health and physical readiness program data indicated that the prevalence of overweight personnel (based on percent body fat[4]) in the Navy during 1987 and 1988 was about 6% (Conway, Trent, & Conway, 1989). The prevalence of morbid obesity (26% or more body fat in males and 36% or more in females) was about 4%. Although the prevalence of obesity in the Navy is slightly lower than in the general population, the current rates still pose a concern for the health and physical readiness of Navy personnel. The purpose of the Navy's physical readiness instruction is to insure that all active duty personnel meet health and physical fitness requirements. Following remedial intervention, failure to meet percent body fat standards can result in detachment from the Navy.

The purpose of the present study was to assess the factors related to obesity in the Navy. The goals of the research were: 1) to describe sociodemographic and dietary differences by obesity status (lean versus overfat), 2) examine correlations between food behaviors, health risk behaviors (i.e. smoking, drinking, exercise), and dietary intake for males and females, and 3) develop a prediction model of obesity that examines the relative contribution of food behaviors and dietary intake while taking into account the effects of sex and age. Specific hypotheses were: 1) higher intakes of fat (cholesterol, saturated fat), protein, and kilocalories will be present in obese subjects than nonobese subjects (dietary hypothesis); and 2) obesity-prone food behaviors will occur more commonly among the obese than the nonobese (food behavior hypothesis).

METHODS

Subjects

The sample consisted of 153 subjects. Sixty-three (or 41.2%) had acceptable percent body fat (i.e. under 23% for men and 31% for women) and were therefore classified as lean. Ninety of the subjects (or 58.5%) exceeded the Navy's percent body fat standards and were classified as overfat (see footnote 3). Members of the overfat group were enrolled in one of two Navy weight reduction programs sponsored by the Navy Medical Clinic, San Diego and Naval Alcohol Rehabilitation Center[5]. Members of the lean control group were contacted through Navy Dental Clinic's annual dental exam[6]. An

effort was made to match the controls and the overfat subjects by sex, ethnicity, and rank. One hundred twenty (or 78%) of the respondents were male and 33 (or 22%) were female. Among the overfat group, 69 (or 77%) were males and 21 (or 23%) were females.

Measures

Demographic Variables. Age, sex, education, marital status, race/ethnicity, and occupational variables were included in the study. Age was the respondent's age in years at last birthday. Education was the number of years of completed schooling. Respondents with less than 8 years of education were assigned 8 years while those with 17 or more years were assigned 17 years (1 or more years of graduate school). Marital status was simply a married/not married dichotomy. Respondents classified themselves racially and ethnically as White, Black, Hispanic, Asian, Pacific Islander, American Indian, or Other. Navy paygrade (E1-E9, W1-W4 and O1-O9) was assigned a level from 1 (E1) to 22 (O9). Duty station referred to either a ship or shore worksite location.

Physical Health Assessment. An anthropometric and physical examination was conducted on each respondent which included assessments of weight, height, radial pulse, and blood pressure (systolic and diastolic measures). Percent body fat was based on height and circumference measures conducted at the neck, waist, and hips in women and neck and abdomen in men (Hodgdon & Beckett, 1984a, 1984b) (see footnote 4).

Health and Food-Related Behaviors. Information was collected on alcohol use, cigarette smoking, and exercise. Alcohol consumption was determined by the amount used weekly and whether it was beer, wine, or liquor. Gram weight of alcohol was determined for a single serving of each beverage (Pennington & Church, 1985) and used to compute total alcohol consumed per day. Number of cigarettes smoked was reported for an average day. Light smokers smoked less than 20 cigarettes a day, while heavy smokers smoked 20 or more cigarettes daily. Using exercise classifications from previous Navy-wide research on health lifestyles (Conway, Trent, & Conway, 1989), specific physical activities were running, swimming, bicycling/life cycle, racket sports, aerobic dance/exercise class, walking for exercise, weight lifting, calisthenics, basketball, baseball/softball, and other. Respondents reported the number of times they were physically active in the last month and the

approximate number of minutes spent in specific exercises. Kilocalorie expenditures per minute per kilogram of weight were ascertained for specific physical activities following the guidelines established by McArdle, Katch, & Katch (1986). Activity patterns were classified as Sedentary, Moderately Active, or Very Active on the basis of total exercise as follows: sedentary, 0.0 to 1.4 kcal/kg/day; moderately active, 1.5 to 2.9 kcal/kg/day; and very active, 3.0 or greater kcal/kg/day (Nice & Conway, 1988; Schoenborn, 1986; Trent & Conway, 1987).

The measurement of food behaviors included food obsessions, emotional eating, and frequencies of specific eating patterns. The food obsession scale and the emotional eating scale were developed in previous research on obesity in the Navy (Hoiberg et al., 1978). The food obsessions scale included 10 statements in which participants indicated the frequency with which they practiced specific food behaviors, from 1 (not at all) to 6 (a lot of the time or daily). The emotional eating scale indicated affective states when eating between meals (i.e. eating when depressed, bored, angry, anxious, frustrated, or lonely) using a similar scaled response format from 1 (not at all) to 6 (a lot of the time). The food obsession and emotional eating scales were highly reliable (Alphas of .87 and .93, respectively; see Appendix, Table A-1). Taken from the Navy's Health and Physical Readiness survey (Conway, Trent & Conway, 1989; Dutton & Conway, 1987; Trent & Conway, 1988), specific eating patterns were determined by frequencies of eating diets high in salt, fat, sugar, lean meats or poultry, fresh fruit and vegetables, whole grains and high fiber food, and eating fast food or in restaurants. Respondents used a 6 item scale from 1 (not at all) to 6 (a lot of the time or daily). Good dietary practices consisted of eating lean meats or poultry, fresh fruit and vegetables, and whole grains and high fiber food, while poor dietary practices consisted of eating foods high in salt, fat, sugar, and eating fast food or in restaurants. Submitted for reliability testing, good dietary practices resulted in a Cronbach's alpha of .74, while poor eating practices resulted in an alpha of .64 (see Appendix, Table A-1).

Dietary Intake. Dietary intake was measured using a 3-day diet record. Respondents noted the specific food or beverage consumed, the approximate amount using household measures (i.e. cup, tablespoon, etc.), and the use of additives (i.e. salt, sugar, butter, mayonnaise, etc.). Foodstuffs were converted to gram weights and broken down by nutritional components using the Ohio Nutrition Program[7]. The daily dietary intake was then computed for all

dietary variables. Specific dietary variables compiled from the present analysis were: kilocalories (kcalories), protein, carbohydrate (CHO), fat, cholesterol, saturated fat, unsaturated fat, alcohol, sucrose, caffeine, fiber, vitamin A, vitamin D, vitamin E, vitamin C, folacin, niacin, riboflavin, thiamine, vitamin B_6, vitamin B_{12}, sodium, potassium, calcium, phosphorus, iodine, iron, magnesium, and zinc.

RESULTS

Demographic and Dietary Description of the Sample

The demographic characteristics of the sample were as follows. The mean age of the sample was 31.8 (s.d.=6.2). Of the 153 respondents, 120 (78%) were male and 33 (22%) were female. The sample had a mean education level of 13.3 years of schooling (s.d.=1.8) or a little over 1 year of college. About 70% of the sample was married. The sample was split ethnically as follows: 78% were Caucasian, 9% were Black, 7% were Hispanic, 3% were Asian, and 3% were from other ethnic groups. On a paygrade scale in which levels were ranked with E-1 being 1 and O-9 being 22, the mean paygrade was 6.6 (s.d.=3.3) or between E-6 and E-7. About 90% were enlisted personnel and 10% officers. Fifty-five percent of the sample were stationed aboard ships and 45% were land-based.

Demographic characteristics varied by sex and obesity status (see Table 1). The difference in mean age between lean and overfat males (29.7 versus 33.6, respectively) was significant ($p<.001$). The same pattern of age differences was observed between lean and overfat females (28.1 versus 33.2 respectively, $p<.01$). This finding lends support to the notion that obesity commonly occurs with age. The lean and overfat did not differ significantly in years of education. Overfat persons, both male and female, were more likely to be married (82% for males and 62% for females). There were no significant differences between lean and overfat individuals by ethnic group (overall or by sex). Almost all overfat subjects (94%) reported previous problems with weight, while 1 in 4 lean subjects (24%) reported having a past weight problem. Previous hypertension diagnoses indicated that 30% of the overfat sample had been diagnosed for high blood pressure at some time in the past (n=27), versus 9.5% of lean individuals (n=6). Thus, the rate of hypertension was approximately three times higher among the obese. The rate of hypertension was also higher among males than females (32% versus 25%).

Lean females had the lowest paygrade of all subsamples (5.8, slightly

below E-6), while lean males had the highest (7.2, slightly above E-7). While only a small proportion of the sample were in the officer ranks (9.8%), which is similar to that found in the Navy at large, only about 5.6% of the officers were overfat. Among males, 9.2% of the sample were officers, while only 2.9% of the overfat personnel were officers. Overall, there was no significant difference between the proportions of lean and overfat subjects by shipboard or shore duty. However, there was a significant difference for females ($p<.05$), with a greater proportion of obese females stationed aboard ships.

Differences in dietary intake between lean and overfat Navy personnel are presented in Table 2. Also included in the table are the recommended dietary allowances (RDAs)[8] for adult males and females of average weight and height. Among males, regardless of percent fat, dietary intake of vitamin E, folacin, vitamin B_6, and zinc fell below the recommended levels. Among females, vitamin E, vitamin B_6 (for only overfat females), and zinc were below the RDAs. In comparison to normal weight males, overfat males consumed significantly fewer calories ($p<.001$), less carbohydrate ($p<.001$), and less caffeine ($p<.001$). Non-significant trends showed that overfat males consumed more cholesterol and sucrose than normal weight males. Overfat females ate significantly more fat ($p<.05$), cholesterol ($p<.05$), saturated fat ($p<.001$), and sodium ($p<.05$) than normal weight females, but consumed less caffeine ($p<.001$).

Table 1. Demographic Information by Sex and Percent Body Fat

	MALES (N=120)					FEMALES (N=33)					TOTAL (N=153)				
	Lean (N=51)		Overfat (N=69)			Lean (N=12)		Overfat (N=21)			Lean (N=63)		Overfat (N=90)		
	N	%	N	%		N	%	N	%		N	%	N	%	
AGE: (Yrs.)															
19-29	29	56.9	15	21.7		8	66.7	5	23.8		37	58.7	20	22.2	
30-39	18	35.3	45	65.2		4	33.3	14	66.7		22	34.9	59	65.6	
40+	4	7.8	9	13.0		-	-	2	9.5		4	6.3	11	12.2	
Mean		29.7		33.6	***		28.1		33.2	**		28.9		33.4	***
SD		6.4		5.8			4.7		5.6			5.6		5.7	
EDUCATION: (Yrs.)															
-12 High Sch.	25	49.0	43	62.3		3	25.0	9	42.9		28	44.4	52	57.8	
13-15 Some Coll.	13	25.5	20	29.0		8	66.7	6	28.6		21	33.3	26	28.9	
16+ Graduate	13	25.5	6	8.7		1	8.3	6	28.6		14	22.2	12	13.3	
Mean		13.6		14.0			13.8		13.7			13.6		13.9	
SD		2.0		10.0			1.6		2.0			1.9		8.8	
MARITAL STATUS:															
Married	32	62.7	56	82.4		5	41.7	13	61.9		37	58.7	69	76.7	
Not Married	19	37.3	12	17.6		7	58.3	8	38.1		26	41.3	20	22.2	
ETHNICITY:															
Black	3	5.9	7	10.6		1	8.3	3	14.3		4	6.4	10	11.5	
Caucasian	38	74.5	53	80.3		10	83.3	16	76.2		48	76.2	69	79.3	
Hispanic	3	5.9	4	6.0		1	8.3	2	9.5		4	6.4	6	6.9	
Other	7	13.7	2	3.0		-	-	-	-		7	11.1	2	2.3	
PAYGRADE:															
1-3 E1-E3	4	7.8	2	2.9		1	8.3	2	2.9		5	7.9	4	4.4	
4-6 E4-E6	30	58.8	45	65.2		9	75.0	15	71.4		39	61.9	60	66.7	
7-9 E7-E9	8	15.7	20	29.0		1	8.3	1	4.8		9	14.3	21	23.3	
10-16 W1-W4/O1-O3	7	13.7	1	1.4		1	8.3	2	9.5		8	12.7	3	3.3	
17-22 O4-O9	2	3.9	1	1.4		-	-	1	4.8		2	3.2	2	2.2	
Mean		7.2		6.2			5.8		6.9			6.5		6.6	
SD		4.3		1.9			3.4		4.1			3.9		3.0	
RANK/DUTY STATION															
Enlisted	42	82.4	67	97.1		11	91.7	18	85.7		53	84.1	85	94.4	
Officer	9	17.6	2	2.9		1	8.3	3	14.3		10	15.9	5	5.6	
Ship	28	54.9	39	56.5		3	25.0	14	66.7		31	49.2	53	58.9	
Shore	23	45.1	30	43.5		9	75.0	7	33.3		32	50.8	37	41.1	
MEDICAL HISTORY:															
Past Overweight															
Yes	12	23.5	64	94.1		3	25.0	21	100.0		15	23.8	85	94.4	
No	39	76.5	5	5.9		9	75.0	-	-		48	76.2	5	5.6	
Hypertension															
Yes	6	11.8	22	32.4		-	-	5	25.0		6	9.5	27	30.0	
No	45	88.2	47	67.6		12	100.0	16	75.0		57	90.5	63	70.0	

Note: Statistical tests were conducted within sex categories and for males and females combined (total). *p<.05, **p<.01, ***p<.001

Table 2. Comparison of Mean Dietary Intake between Lean and Overfat Personnel controlling for Sex[1]

Nutritive/Non-nutritive Foodstuffs	MALES				FEMALES			
	RDA[2]	LEAN	OVERFAT		RDA	LEAN	OVERFAT	
Kcalories	2700	2962	2356	***	2000	2103	2286	
Protein (gms)	56	106	99		46	71	87	
Fat-Soluble								
Vitamin A (IU)	5000	7547	10790		4000	8573	8162	
Vitamin D (IU)	-	149	123		-	112	83	
Vitamin E (IU)	15	5	4		12	5	5	
Water-Soluble								
Ascorbic Acid (mgs)	45	217	162		45	178	192	
Folacin (mcg)	400	314	289		400	535	304	
Niacin (mg)	18	35	33		13	43	29	
Riboflavin (mg)	1.6	2.5	2.5		1.2	3.2	2.3	
Thiamine (mg)	1.4	6.5	8.8		1.0	2.7	2.4	
Vitamin B_6 (mg)	2.0	1.6	1.7		2.0	2.9	1.8	
Vitamin B_{12} (mg)	3.0	7.6	11.2		3.0	14.2	5.3	
Minerals								
Calcium (mg)	800	1063	996		800	783	909	
Phosphorus (mg)	800	1556	1505		800	1257	1381	
Iodine (mcg)	130	227	2667		100	133	233	
Iron (mg)	10	23	22		18	29	27	
Magnesium (mg)	350	426	258		300	254	221	
Zinc (mg)	15	8	9		15	8	7	
Carbohydrate (gms)	-	330	243	***	-	313	242	
Fat (gms)	-	130	109		-	70	104	*
Cholesterol (mgs)	-	348	362		-	187	370	*
Saturated Fat (gms)	-	35	30		-	18	35	***
Unsaturated Fat (gms)	-	9	7		-	6	8	
Alcohol (gms)	-	11	8		-	6	7	
Fiber (gms)	-	5	5		-	5	6	
Sucrose (gms)	-	44	65		-	85	54	
Caffeine (mgs)	-	1227	739	***	-	1199	341	***
Sodium (mgs)	-	3878	3266		-	2254	3389	*
Potassium (mgs)	-	3095	2974		-	2138	2936	

* $p<.05$
** $p<.01$
*** $p<.001$

[1] Statistical analyses were conducted between lean and overfat males, and lean and overfat females.

[2] See footnote 8.

Table 3. Percent Distributions and Means of Food Behaviors and Health Behavior Risk Factors by Sex

	MALES				FEMALES				TOTAL			
	No/Low %	Moderate %	High %	Mean	No/Low %	Moderate %	High %	Mean	No/Low %	Moderate %	High %	Mean
FOOD BEHAVIORS:[a]												
EAT SALTY FOOD	29	53	19	3.4	27	58	15	3.2	28	54	18	3.3
EAT HIGH FAT FOOD	13	44	44	4.2	24	42	33	3.9	15	43	42	4.2
EAT SUGAR-RICH FOOD	30	48	22	3.4	18	46	36	3.9	28	47	25	3.5
EAT LEAN MEATS/POULTRY	17	49	35	3.9	6	42	52	4.6	15	47	38	4.1
EAT FRUIT/VEGETABLES	17	55	29	3.8	15	30	55	4.3	17	49	34	3.9
EAT WHOLE GRAINS/FIBER	33	45	23	3.3	15	42	42	4.1	29	44	27	3.5
EAT FAST FOOD/IN REST.	30	47	24	3.4	24	42	33	3.6	28	45	26	3.4
GOOD FOOD PRACTICES	19	45	36	3.7	30	30	39	4.3	22	42	37	3.8
POOR FOOD PRACTICES	31	31	38	3.6	33	24	42	3.7	31	30	39	3.6
FOOD OBSESSION	46	33	21	2.9	30	15	55	3.3	42	29	29	3.0
EMOTIONAL EATING	36	37	28	2.6	39	35	27	3.2	36	36	27	2.7
HEALTH BEHAVIOR RISK FACTORS:												
DRINK ALCOHOL[b]	76	11	13	9.6	82	9	9	6.7	77	11	12	8.9
EXERCISE[c]	15	3	82	16.6	9	12	79	13.5	14	5	82	15.9
SMOKE CIGARETTES[d]	77	12	12	4.3	82	9	9	3.4	78	11	11	4.1

[a] Food Behaviors: No/Low, 1 - 2 ((Not at all - occasionally);
Moderate, 3 - 4 (Some of the time - a fair amount of the time);
High, 5 - 6 (Quite a lot of the time - daily or almost daily)(Hoiberg, 1978; Trent & Conway, 1988).

[b] Drink Alcohol: No/Low, 0 - 12 gms. of alcohol/day or the equivalent of not drinking or having approximately 1 drink/day;
Moderate, 12 - 24 gms. of alcohol/day or the general equivalent of 2 drinks/day;
High, 24+ gms of alcohol/day or the general equivalent of 3 or more drinks/day (Bowes & Church 1975).

[c] Exercise: No/Low, no exercise or sedentary exercise equivalent to utilizing 0.0 - 1.4 Kcal/Kg/day;
Moderate, moderately active or equivalent to utilizing 1.5 - 2.9 Kcal/Kg/day;
High, very active or equivalent to utilizing 3.0 or greater Kcal/Kg/day (Schoenborn, 1986).

[d] Smoke Cigarettes: No/Low, or Non-Smoker;
Moderate, or Light Smoker equivalent to smoking less than 19 cigarettes/day;
High, or Heavy Smoker equivalent to smoking 20 or more cigarettes/day (Kornitzer et al., 1987).

Distribution of Food Behaviors and Health Behavior Risk Factors

Overall, on the 6-point scales (1= low frequency, 6=high frequency), the food behavior practiced most frequently was eating high fat food (4.2) (see Table 3). This was followed by eating lean meats and poultry (4.1), fresh fruit and vegetables (3.9), good food practices (3.8), and poor food practices (3.6). While these factors may seem somewhat inconsistent, they really are not. For instance, an individual may have high scores for both good food practices and poor practices by consuming a wide variety of foods. Females exceeded males in the frequencies of practicing good food habits (4.3 versus 3.7, $p<.01$), eating whole grains and high fiber food (4.1 versus 3.3, $p<.01$), and lean meat and poultry (4.6 versus 3.9, $p<.05$). Females also exceeded males in obsessive eating patterns (3.3 versus 2.9, $p<.1$) and emotional eating behaviors (3.2 versus 2.6, $p<.05$).

Distribution of health behavior risk factors indicated that 76% of the males had low alcohol consumption: 38% did not drink and 38% had no more than 1 drink per day. Among females, 82% had low alcohol consumption: 17% did not drink and 65% drank no more than 1 drink per day. A higher percentage of males than females were heavy drinkers (3 or more drinks per day or about 24 gms. of alcohol daily): 13% for males versus 9% for females. Although 14% of the sample was classified as sedentary (males: 15%; females: 9%), 82% were physically very active (utilizing 3.0 or more kcalories/ Kg/day). Smokers constituted 22.2% of the Navy sample (males: 23.3%; females: 18.2%), while heavy smokers, those smoking 20 or more cigarettes per day, represented 50% of total smokers (males: 50%; females: 50%).

Correlations between Dietary Intake, Behaviors, and Risk Factors

In order to examine the influence of behavior upon food intake, correlational analysis was conducted upon food behaviors, health risk behaviors, and dietary intake irrespective of percent body fat (see Tables 4 and 5). Self-report eating behavior variables (good dietary practices, poor dietary practices, emotional eating, and food obsession) and dietary intake data collected from the three day logs were used. Evaluation of the distribution of health behaviors in the sample indicated there were important food behavior patterns and health behavior risk factors present in the Navy sample, as well as notable differences between males and females.

Dietary Habits in Males. The associations between behavior and food intake among males are reported in Table 4. Eating high fat food such as steak, beef, and dairy products (self-report data) was significantly and positively associated with dietary intake of calories ($p<.05$), protein ($p<.01$), fat ($p<.05$), unsaturated fat ($p<.05$), sucrose ($p<.01$), and alcohol ($p<.01$) (see Table 4). A diet high in lean meat and poultry, and fresh fruit and vegetables (self-report data) resulted in lower intake of saturated fat generally ($p<.05$ and $p<.05$), not unexpected findings.

The good dietary practices scale (i.e., eating a diet of lean meats/poultry, fresh fruit and vegetables, whole grains, and high fiber food) showed that healthier dietary practices were significantly associated with decreased consumption of saturated fat ($p<.05$). The scaled variable of poor dietary practices (i.e., eating a diet high in salt, sugar, fat, eat fast food or in restaurants) showed that higher numbers of poor eating habits were associated with higher protein and sugar consumption ($p<.05$ and $p=.01$). Eating fast food or in restaurants was associated with higher intake of sugar in the diet ($p<.01$), and a significantly higher consumption of alcohol ($p<.05$).

Emotional eating among males (i.e., eating when depressed, bored, angry, anxious, frustrated and lonely) was significantly related to an increased intake of potassium ($p<.05$) and calcium ($p<.05$), while food obsessions were negatively correlated with caffeine intake ($p<.05$).

Table 5 reports the associations between dietary intake and specific health behavior risk factors (i.e. cigarette smoking, alcohol use, exercise, present weight, and blood pressure). Males who smoked generally consumed less protein ($p=.05$), more sugar ($p=.05$), and more caffeinated beverages ($p<.001$). The higher the exercise activities per week, the less likely males were to consume excess calories ($p<.05$), dietary fat ($p=.01$), saturated fat ($p<.05$), and potassium ($p<.05$), but the more likely they were to consume alcohol ($p<.05$). There was a strong inverse relationship between weight and caffeine--lower weight was accompanied by higher intake of caffeinated beverages ($p<.01$). Carbohydrate intake was lower with higher systolic and diastolic blood pressures ($p<.05$ and $p<.05$). With higher elevations of systolic pressure alone, sugar consumption was noted to be higher ($p<.05$), but vitamin C intake was more likely to be low ($p<.05$).

Dietary Habits in Females Table 4 reports the associations between food behaviors and food intake among females. Females eating foods that were high in salt (i.e. chips, fritos, french fries, crackers, and peanuts) and sugar (i.e. cookies, ice cream, cakes, soft drinks) were more likely to consume fat ($p<.05$ and $p<.01$), cholesterol ($p<.05$ and $p=.01$), sodium ($p=.01$ and $p=.01$), and calcium ($p<.05$ and $p=.01$). Eating sugar-rich foods alone was also associated with increases in calorie consumption ($p<.05$), higher intakes of protein ($p<.01$), saturated and unsaturated fat ($p<.05$ and $p<.05$), potassium ($p=.01$), and vitamin C ($p=.05$). Conversely, eating fresh fruit and vegetables was associated with reduced intakes of fat ($p<.05$), cholesterol ($p<.05$), saturated fat ($p=.05$), sodium ($p=.01$), potassium ($p<.05$), and alcohol ($p<.01$), but increased levels of sucrose ($p<.05$).

The practice of good dietary habits (i.e. eating lean meats/poultry, fresh fruit/vegetables, whole grains, and high fiber food) was associated with a reduced intake of alcohol ($p<.05$), but increased intake of dietary sugar ($p<.05$). Poor dietary practices (i.e. eating foods high in salt, sugar, fat, eating fast food or in restaurants) were associated with increased consumption of protein ($p=.01$), dietary fat ($p=.01$), cholesterol ($p<.01$), saturated fat ($p<.05$), sodium ($p=.01$), potassium ($p<.05$), and calcium ($p<.05$).

Food obsessions were highly associated with the same nutritional elements that were shown to accompany poor dietary habits with the exclusion of calcium. However, dietary fat, cholesterol, and sodium showed significantly higher correlations with food obsessions (fat: $p<.01$; chol: $p<.01$; sodium: $p<.01$). Emotional eating showed significant, positive correlations with cholesterol ($p=.01$), saturated fat ($p=.01$), potassium ($p=.01$), and calcium ($p<.05$). The behavioral problems surrounding food choices appear to promote the selection of high risk foods of fat, saturated fat, cholesterol and sodium among females.

Health behavior risk factors related to dietary intake are reported in Table 5. Cigarette smoking showed a significant association with higher intakes of potassium ($p<.05$) and vitamin C ($p<.05$), as well as a very strong association with caffeine intake ($p<.001$). Alcohol use was significantly related to higher intake of cholesterol ($p=.05$). Higher levels of exercise were associated with reduced intake of unsaturated fat ($p<.05$), but increased consumption of sucrose ($p=.01$). Higher weight elevations in females were significantly associated with increases in cholesterol ($p=.01$), saturated fat ($p<.05$), and alcohol consumption ($p<.05$), but a reduced intake of caffeinated beverages ($p<.01$). The latter relationship was also reported for leaner

Table 4. Correlations between Dietary Intake and Food Behaviors by Sex

		Kcal	Protein	Fat	CHO	Choles-terol	Sat'd Fat	Unsat'd Fat	Sodium	Potas-sium	Caf-feine	Alcohol	Sucrose	Fiber	Vit C	Calcium
EAT SALTY FOOD																
Females	r	.15	.28	.31	.02	.35	.19	.24	.39	.21	-.08	.48	-.09	.02	-.05	.33
	p	.21	.06	.04 *	.46	.03 *	.15	.10	.01 **	.13	.40	.12	.31	.46	.39	.03 *
Males	r	.06	.01	.07	.05	.002	.02	.07	.07	.02	.06	-.02	.07	.04	-.15	.02
	p	.28	.45	.24	.30	.49	.42	.25	.24	.44	.33	.47	.26	.35	.06	.43
EAT HIGH FAT FOOD																
Females	r	-.07	.11	.13	-.18	.28	.17	-.01	.14	.21	.19	.43	.01	-.02	-.11	.09
	p	.35	.27	.23	.16	.07	.18	.49	.22	.13	.26	.14	.47	.46	.28	.31
Males	r	.18	.26	.18	.10	.11	.12	.21	.05	.13	-.27	.15	.26	.01	-.02	.13
	p	.03 *	.00 ***	.03 *	.17	.14	.11	.02 *	.31	.09	.03 *	.21	.00 ***	.36	.44	.09
EAT SUGAR-RICH FOOD																
Females	r	.37	.49	.46	.20	.43	.37	.35	.39	.40	-.01	-.02	-.18	.09	.29	.45
	p	.02 *	.00 ***	.00 ***	.14	.01 **	.02 *	.03 *	.01 **	.01 **	.48	.48	.17	.31	.05 *	.01 **
Males	r	.13	.14	.16	.14	.05	.03	.10	.06	.09	-.27	-.29	.16	-.05	-.05	.12
	p	.09	.08	.06	.08	.32	.40	.16	.26	.19	.03 *	.06	.06	.32	.30	.11
EAT LEAN MEAT/POULTRY																
Females	r	-.22	-.08	-.21	-.18	-.16	-.19	.15	-.19	-.19	-.19	-.001	.25	-.01	-.17	-.13
	p	.12	.34	.12	.17	.19	.16	.21	.15	.16	.26	.50	.08	.48	.17	.25
Males	r	-.10	-.03	-.11	-.11	.06	-.17	-.04	.07	-.06	-.17	.29	-.08	-.09	-.04	-.11
	p	.16	.38	.13	.13	.29	.04 *	.34	.24	.29	.12	.06	.21	.18	.36	.14
EAT FRESH FRUIT/VEGETABLES																
Females	r	-.37	-.28	-.34	-.24	-.35	-.30	.007	-.43	-.33	-.33	-.54	.38	-.14	-.19	-.20
	p	.02 *	.06	.03 *	.09	.03 *	.05 *	.48	.01 **	.03 *	.12	.08	.02 *	.22	.16	.14
Males	r	-.05	-.11	-.10	.03	-.15	-.17	.01	.08	.03	-.18	.20	.13	.01	-.02	-.01
	p	.33	.13	.16	.37	.07	.04 *	.45	.20	.38	.11	.14	.10	.45	.42	.46
EAT WHOLE GRAINS/HIGH FIBER FOOD																
Females	r	.03	.06	.005	.07	-.12	-.13	.18	.01	-.16	-.63	.53	.20	.13	-.09	.05
	p	.43	.38	.49	.36	.26	.25	.16	.47	.19	.01 **	.09	.14	.24	.32	.40
Males	r	-.09	-.09	-.12	-.07	.04	-.10	.01	.06	-.05	-.30	.24	-.05	-.08	-.03	-.10
	p	.18	.18	.11	.25	.36	.15	.46	.27	.32	.02 *	.09	.29	.22	.37	.15

* = $p<.05$
** = $p<.01$
*** = $p<.001$

Table 4. Correlations between Dietary Intake and Food Behaviors by Sex (cont.)

		Kcal	Protein	Fat	CHO	Cholesterol	Sat'd Fat	Unsat'd Fat	Sodium	Potassium	Caffeine	Alcohol	Sucrose	Fiber	Vit C	Calcium
GOOD DIETARY HABITS																
Females	r	-.22	-.12	-.22	-.14	-.25	-.24	.12	-.24	-.27	-.44	-.47	.32	-.01	-.17	-.11
	p	.12	.25	.12	.23	.09	.10	.26	.09	.07	.06	.12	.04 *	.47	.17	.28
Males	r	-.10	-.10	-.14	-.06	-.03	-.19	-.01	.09	-.03	-.28	.31	.000	-.07	-.04	-.09
	p	.16	.16	.08	.28	.40	.03 *	.48	.18	.38	.03 *	.04 *	.50	.26	.36	.18
POOR DIETARY HABITS																
Females	r	.18	.41	.42	-.01	.50	.37	.16	.40	.38	.16	.28	-.03	-.05	.09	.37
	p	16	.01 **	.01 **	.47	.00 ***	.02 *	.19	.01 **	.02 *	.30	.26	.43	.40	.32	.02 *
Males	r	.15	.17	.16	.13	.06	.02	.16	.11	.10	-.10	-.12	.25	-.01	-.11	.13
	p	.06	.04 *	.06	.09	.27	.41	.06	.14	.16	.24	.26	.01 **	.45	.14	.10
EAT FAST FOOD OR IN RESTAURANTS																
Females	r	.05	.22	.22	-.07	.29	.24	-.12	.18	.19	.27	-.19	.15	-.20	.08	.15
	p	.39	.12	.12	.36	.06	.10	.26	.16	.15	.17	.33	.21	.14	.34	.21
Males	r	.15	.17	.10	.14	.10	.03	.01	-.18	.13	.08	.16	.30	-.08	.07	.14
	p	.10	.07	.20	.11	.18	.40	.48	.06	.12	.33	.24	.00 ***	.24	.26	.11
FOOD OBSESSION																
Females	r	.18	.33	.47	-.07	.54	.45	.12	.59	.33	.26	.20	.02	.07	.03	.20
	p	.16	.03 *	.00 ***	.36	.00 ***	.01 **	.25	.00 ***	.03 *	.18	.32	.47	.36	.44	.13
Males	r	-.08	.07	-.03	-.12	.14	.04	-.03	-.04	.07	-.10	-.18	.09	.01	-.04	.10
	p	.23	.24	.38	.12	.08	.36	.39	.33	.23	.24	.18	.18	.45	.37	.16
EMOTIONAL EATING																
Females	r	.05	.29	.29	-.12	.48	.51	.08	.30	.49	.20	.60	-.16	-.01	.09	.43
	p	.41	.08	.08	.28	.01 **	.01 **	.36	.07	.01 **	.29	.14	.22	.48	.34	.02 *
Males	r	-.004	.15	.06	-.07	.15	.11	-.04	.12	.21	.07	-.33	.01	.09	.07	.18
	p	.49	.08	.28	.25	.08	.14	.34	.12	.02 *	.32	.04 *	.45	.20	.26	.04 *

* = $p<.05$
** = $p<.01$
*** = $p<.001$

Table 5. Correlations between Dietary Intake, Health Behaviors, and Physical Health Risk Factors by Sex

		Kcal	Protein	Fat	CHO	Choles-terol	Sat'd Fat	Unsat'd Fat	Sodium	Potas-sium	Caf-feine	Alcohol	Sucrose	Fiber	Vit C	Calcium
SMOKE CIGARETTES																
Females	r	.17	.18	.21	.09	.15	.16	-.04	-.10	.35	.48	.36	-.009	- 14	.37	.08
	p	.17	.16	.13	.32	.21	.20	.42	.29	.03 *	.04 *	.19	.48	.23	.02 *	.33
Males	r	-.13	-.16	-.12	-.14	-.09	-.06	.02	-.10	-.13	-.04	.11	.16	-.11	-.14	-.03
	p	.10	.05 *	.12	.08	.19	26	.44	.17	.10	.40	.27	.05 *	.14	.08	.38
ALCOHOL																
Females	r	-.01	.06	.19	-.16	.30	.22	.14	.27	.06	.45	.64	-.23	-.04	-.18	-.10
	p	.49	.37	.15	.19	.05 *	.12	.22	.07	.37	.05 *	.05 *	.11	.42	.17	.30
Males	r	.02	.01	-.01	-.07	-.03	-.02	.02	.03	-.01	.04	.30	-.02	-.05	-.02	-.07
	p	.42	.46	.47	.23	.37	.44	.42	.36	.48	.40	.05 *	.41	.32	.44	.25
EXERCISE PER WEEK (HRS.)																
Females	r	-.003	-.07	-.19	.11	-.15	-.06	-.39	-.16	-.13	-.04	-.46	.40	-.07	.17	-.17
	p	.49	.35	.16	.28	.21	.37	.02 *	.19	.24	.45	.13	.01 *	.36	.18	.18
Males	r	-.18	-.12	-.22	-.15	-.09	-.21	-.14	-.07	-.21	.09	.30	-.10	-.10	-.06	-.14
	p	.04 *	.11	.01 **	.06	.17	.02 *	.08	.23	.02 *	.28	.05 *	.17	.15	.27	.09
WEIGHT (LBS.)																
Females	r	-.01	.15	.23	-.18	.41	.33	.07	.24	.23	.15	.67	-.16	.04	.03	.06
	p	.48	.21	.10	.17	.01 **	.04 *	.35	.09	.10	.31	.04 *	.19	.42	.43	.38
Males	r	-.18	.004	-.06	-.29	.04	.005	-.14	-.004	-.05	.24	-.22	.04	-.04	-.10	-.003
	p	.03 *	.48	.26	.00 ***	.33	.48	.07	.49	.32	.05 *	.12	.33	.33	.17	.49
SYSTOLIC PRESSURE																
Females	r	.03	.08	.09	-.02	.46	.45	-.01	.05	.25	.21	.83	-.05	.04	.20	.13
	p	.44	.33	.32	.46	.00 ***	.01 **	.47	.40	.09	.24	.00 ***	.40	.42	.14	.23
Males	r	-.06	.03	.03	-.17	-.01	-.04	-.06	.04	-.10	.04	.15	.21	-.002	-.21	-.03
	p	.29	.39	.39	.04 *	.45	.35	.28	.36	.17	.38	.21	.02 *	.49	.02 *	.37
DIASTOLIC PRESSURE																
Females	r	-.23	-.15	-.04	-.26	.32	.29	.02	.0004	-.06	.03	.51	-.08	-.15	-.14	-.07
	p	.10	.21	.41	.08	.04 *	.06	.47	.50	.36	.46	.10	.33	.21	.22	.35
Males	r	-.14	-.06	-.06	-.21	.01	.01	-.13	-.06	-.08	.15	-.03	.13	.02	-.12	-.05
	p	.08	.28	.29	.02 *	.47	.48	.11	.27	.20	.15	.44	.09	.42	.12	.30

* = p<.05
** = p<.01
*** = p<.001

males. Increases in systolic and diastolic blood pressures were highly related to cholesterol ($p<.01$ and $p<.05$), while systolic pressure alone showed a significant association with higher intake of saturated fat ($p=.01$).

Dietary and Behavioral Predictors of Obesity

Food behaviors and dietary intake were used in a regression analysis to estimate percent body fat (see Table 6). Since subjects could naturally vary in their percentage of body fat with age and sex (and interactions of these with behaviors and diet), they were all considered as possible predictors of percent body fat. The regression procedure used stepwise selection to include or exclude independent variables (age and sex, food behaviors, dietary intake and interaction variables) from the model. The resulting model showed that sex, carbohydrate intake, and the interaction of food obsessions with age accounted for 45% of the explained variance in percent body fat. Other factors constant, females generally had about 7% more body fat than males. Carbohydrate intake was negatively related to percent body fat. The more obese were less likely to eat carbohydrates than the less obese. This suggests that the obese were more likely to consume protein and fats than the nonobese although these findings did not enter into the equation. Generally, the percentage of body fat increased with age. Older personnel were more likely to be obese than younger personnel. Holding other variables constant, body fat increased by about .1% per year. Also food obsessions were positively related to percent body fat and obesity. Food obsessions interacted with age such that food obsessions present more of a problem in terms of increased body fat percentage with age. This may be due, in large measure, to a cumulation of excess body fat associated with food obsessions with increasing age. Also, it may be due to a greater tendency for periodic food binges to be more easily translated into body fat with increased age.

The change in explained variance (R^2) in the model when a variable is entered in the model last (part correlation) indicates the variable's unique contribution to total R^2. The largest portion of explained variance was from the Age X Food Obsession variable which had a part correlation (R^2) of .25, independently accounting for more than half of the total variance explained in the model. Sex independently accounted for .09 of total R^2 and carbohydrate intake accounted for .04 of the total explained variance. Of the variables in the model, carbohydrate intake and food obsessions can conceivably be modified by the individual to reduce percent body fat.

Table 6. Multiple Regression of Diet and Food Behaviors with Percent Body Fat (N=153)

Predictor	b	Std. Error of b	Beta	R^2 Change When Entered Last	
Sex (male=1; female=0)	-5.892	1.503	-.303	.090	***
CHO	-.012	.004	-.204	.041	**
Food Obsession X Age	.102	.014	.502	.246	***
(Constant)	25.069	2.250			
R	.67				
R^2	.45				

* = p<.05
** = p<.01
*** = p<.001

DISCUSSION

One of the two hypotheses in the present research was supported. Receiving little support, the dietary hypothesis stated that overweight personnel would consume more fat, protein, and kilocalories than normal weight individuals. Overweight males, in fact, consumed significantly fewer calories and less carbohydrate than normal weight males; however, overweight females consumed significantly more fat, cholesterol, saturated fat, and sodium than normal weight females. When examined with other predictor variables, however, these nutritional elements were not associated with higher percent fat. The food behavior hypothesis, which stated that obesity-prone behaviors would occur more commonly among overweight personnel, received support. Strong bivariate relationships were indicated between specific obesity-prone behaviors and food intake for both males and females irrespective of weight status. Food obsessions was the single behavioral predictor of obesity in the sample.

Obesity in this sample showed a strong relationship to age. Overweight subjects were, on average, 4 to 5 years older than their lean counterparts (for both males and females). This should not be taken as an inevitable consequence of aging, although the effects of age probably act synergistically with predisposing factors. The obese reported more problems with overweight in the past, were married, and were more likely Caucasian. Of total overweight subjects, females had the highest proportion of percent fat.

Dietary differences were most pronounced among females. Overweight females consumed higher intakes of calories, protein, vitamin C, calcium, potassium (all non-significant), and significantly higher intakes of fat, cholesterol, saturated fat, and sodium than normal weight women. Overweight males ate less protein, fat, saturated fat, alcohol, and sodium than normal weight males. They also consumed significantly fewer calories, less carbohydrate and caffeinated beverages. Reduced carbohydrate intake was a characteristic found most commonly in the obese, irrespective of gender. Additionally, reduced carbohydrate intake was clearly in evidence with older rather than younger subjects. This finding has important implications for nutritional intervention for weight reduction. Higher intake of carbohydrates would go far in reducing the amount of fat and protein in the diet to acceptable levels.

A significant proportion of the sample evidenced behavioral problems related to food intake. Approximately 54% of males and 70% of females, irrespective of weight classification, had moderate to high rates of food obsessions, while 65% of males and 62% of females reported moderate to high rates of emotional eating behaviors. Of particular note, food obsessions, more pronounced in women, generally resulted in the consumption of foods high in protein, fat, cholesterol, saturated fat, and sodium. Emotional eating behaviors were associated with higher intakes of cholesterol, saturated fat, potassium, and calcium in women, with the latter two associated with emotional eating behaviors in men. Overweight males and females had more behavioral problems associated with food intake than those with normal weight.

The regression model for estimating percent body fat found that sex, carbohydrate intake, and the interaction of food obsessions with age were the most powerful predictors. These three variables explained 45% of the variance in percent body fat. The interaction of age and food obsessions independently explained 25% of the variance in percent body fat. While other factors are associated with percent body fat, they generally operate through

these factors. Although percent body fat is definitely influenced by such uncontrollable factors as age and sex, the model reveals that an individual's percent body fat can be modified through diet and behavior. Specifically, increased carbohydrate intake (coupled with a corresponding decrease in protein and fat) may reduce percent body fat. Reduction in food obsessions (and emotional eating which is substantially correlated with food obsessions) may also reduce percent body fat. Since those with higher percent fat more commonly ate when they were depressed, bored, angry, anxious, frustrated, or lonely, behavioral intervention for coping with emotional problems and which diminishes the reliance on food by promoting alternative behaviors can be used in the battle against obesity.

Two of the more striking food-related behaviors ascertained through correlational analysis were alcohol consumption in males and sugar intake in females. When females consumed sugar-rich food, they were more likely to eat foods high in calories, protein, fat, carbohydrate, cholesterol, saturated fat, unsaturated fat, sodium, potassium, vitamin C, and calcium. Females also consumed more sucrose in the presence of good food habits and higher physical activity. Not all of the nutritional elements have negative consequences in terms of body fat; therefore, nutritional education appears strongly warranted regarding use of sucrose in the diet.

The majority of males (76%) reported no or low use of alcohol daily. However, higher intake of high fat food was associated with increased alcohol use. In addition, eating snack food or in restaurants was commonly associated with greater alcohol use. Alcohol use was also higher in the presence of increased physical exercise. The sugar/alcohol relationship with physical activity could indicate gender-specific food preferences and kcalorie demand following physical exertion.

Implications for the Navy's Health and Physical Readiness Program suggest there are different mechanisms involved in obesity which are specific to males and females. There is a common assumption that people who are obese eat more and exercise less than normal weight individuals. Current results indicated that obese Navy personnel generally ate approximately the same or fewer calories than nonobese individuals. There were no significant differences in physical activity for either males or females by obesity status. Although diet is, of course, an essential element in the etiology of obesity, obesity is associated with a wide range of factors that include age, sex, metabolism, family aggregation or genetics, and socioeconomic status. Given the complex nature and etiology of obesity, obese personnel may be

unfairly penalized for failure to reduce weight based upon diet and exercise alone. Although the typical diet of the obese does not appear dramatically different from the nonobese with the exception of reduced carbohydrate intake, the periodic consumption of increased calories in the presence of behavioral arousal (e.g., obsessional or emotional eating) may result in higher rates of obesity. It's also possible that such episodic eating may be under-reported using current dietary assessment methods.

The Navy offers out-patient weight loss programs as well as in-patient hospital-based weight reduction programs. Treatment focus should target behavior change strategies that involve learning alternative behaviors to eating and food choice counseling. Additionally, psychological counseling should be made available because the obese tend to exhibit a higher frequency of eating behaviors arising from emotional or affective states than the nonobese. Implementing these changes could make a measurable impact on the rate of obesity in the Navy.

Table A-1. Items Comprising the Four Dietary Scales

Scale	Item
	How often do you practice the following things? **1....2....3....4....5....6** **Not at all** — **A lot or daily**
GOOD DIETARY PRACTICES (alpha = .74)	1. Eat lean meats or poultry 2. Eat fresh fruit and vegetables 3. Eat whole grains and fiber
POOR DIETARY PRACTICES (alpha = .64)	1. Eat salty food 2. Eat high fat food 3. Eat sugar-rich food 4. Eat fast food or in restaurants
	How often do you do the following things? **1....2....3....4....5....6** **Not at all** — **A lot of the time/daily**
FOOD OBSESSION (alpha = .87)	1. Feel helpless about food. 2. Tend to overeat though full. 3. Eat more when alone. 4. Snack between meals when not hungry. 5. Difficulty resisting rich food. 6. You reward yourself with food for good behavior. 7. Parents used food as a reward. 8. Are you a fast eater? 9. Have you hidden food to eat later.
	When you have to eat between meals, how do you describe your feelings? **1....2....3....4....5....6** **Not at all** — **A lot of the time/daily**
EMOTIONAL EATING (alpha = .93)	1. depressed 2. bored 3. angry 4. anxious 5. frustrated 6. lonely

Table A-2. Zero-Order Correlations between Independent Variables and Percent Body Fat by Sex

	FEMALES	MALES
DEMOGRAPHIC VARIABLES		
Age	.30 *	.31 ***
Ethnic Identity	.22	.11
Education	-.03	.03
Marital Status	.16	.33 ***
Family Obesity	.40 *	.54 ***
Paygrade	.09	-.26 ***
Duty Station	.36 *	-.00
Officer Rank	.08	-.38 ***
HEALTH & FOOD BEHAVIORS		
Wine Intake	.02	-.06
Liquor Intake	-.30 *	.14
Beer Intake	-.01	-.19 *
Smoke Cigarettes	-.33 *	.01
Exercise per Week	-.05	-.08
Emotional Eating	.34 *	.56 ***
Food Obsession	.36 *	.54 ***
Good Food Practices	-.10	-.14
Bad Food Practices	.21	.06
Eat Salty Food	.06	.04
Eat High Fat Food	.07	.16 *
Eat Sugar-Rich Food	.23	.01
Eat Lean Meat/Poultry	.08	-.04
Eat Fresh Fruit/Vegetables	-.20	-.16 *
Eat Whole Grains/High Fiber Food	-.11	-.11
Eat Fast Food or in Restaurants	.16	-.06
DIETARY INTAKE		
Kcalories	-.11	-.26 ***
Protein	.03	-.07
Fat	.16	-.14
Carbohydrate	-.23	-.34 ***
Cholesterol	.29	.08
Saturated Fat	.31 *	-.05
Unsaturated Fat	.07	-.14
Sodium	.16	-.07
Potassium	.05	-.09
Caffeine	-.36	-.13
Alcohol	.05	-.09
Sucrose	-.13	.07
Fiber	-.07	-.06
Vitamin C	-.05	-.13
Calcium	-.08	-.08

* $p<.05$
** $p<.01$
*** $p<.001$

Footnotes

1. Dr. Barbara C. Du Bois is a Research Associate and Medical Anthropologist with the National Research Council, National Academy of Sciences, 2101 Constitution Ave., Washington, DC and the Health Services Research Dept., Naval Health Research Center, P.O. Box 85122, San Diego, CA 92138-9174. Dr. Jerry D. Goodman is a Statistical Consultant and Sociologist with Naval Health Research Center. Dr. Terry L. Conway, is a Research Psychologist with the Health Services Research Dept., Naval Health Research Center.

2. Obesity assessment in the NHANES survey was based on height and weight measurements for the calculation of body mass index (BMI = Weight [kg]/ height[m]^2).

3. Results from the Framingham study showed that for every 10% rise in relative weight, average fasting blood sugar increased 2 mg/dl, plasma cholesterol increased 12 mg/dl, and systolic blood pressure increased 6.5 mm of mercury (Kannel and Gordon, 1979).

4. Obesity assessment methods used in the Navy rely on percent body fat determination rather than the body mass index, which does not separate lean body mass from fat body mass. The Navy's percent body fat assessment method relies on height and circumference measures of the neck and abdomen for males, and neck, waist, and hips for females, and are evaluated with separate body density scores by sex (Hodgdon and Beckett, 1984a, 1984b). This method of assessing percent body fat was developed for rapid screening of obesity and was shown to be highly correlated with underwater weighing. Following recommendations put forth by the National Institutes of Health, the Navy's standards for acceptable percent fat in males is 22% or less and 30% or less in females. Moderate overfat in males is 23% to 25% body fat; in females, 31% to 35% body fat. Morbid obesity in males is 26% or more body fat and 36% or more in females.

5. The Naval Medical Clinic's behavioral weight control clinic is an out-patient weight reduction program that utilizes the food exchange system, health education, and guided group discussion. The weight reduction program is sponsored by the Education and Training Department, Naval

Medical Clinic, San Diego Naval Station, P.O. Box 153, San Diego, CA 92136. An in-patient weight reduction program, operated under the auspices of the Naval Alcohol Rehabilitation Center, Miramar Naval Air Station in San Diego, utilizes the food exchange system, guided group discussion, health education, and behavior modification. The weight loss approach is a 12 step program, patterned after Overeater's Anonymous treatment program.

6. Navy policy requires an annual dental screening for all personnel. Control group selection was conducted at the Navy Dental Clinic, San Diego Naval Station, due to the non-selective nature and large number of personnel entering the clinic on a daily basis.

7. The Ohio Nutrition Program is a mainframe statistical software program that analyzes dietary data from gram weights. Dietary output includes the average daily consumption of nutritive and non-nutritive foodstuffs. Graphs show dietary averages in relation to the recommended dietary allowances (RDAs) and indicate if nutrient deficiencies are present for the individual's sex, age, and weight.

8. The recommended dietary allowances (RDAs) are based upon requirements for an adult between the ages of 23 to 50 - if male, with an average weight of 154 lbs. and 69 inches in height; if female, with an average weight of 128 lbs. and 65 inches in height (Food and Nutrition Board, 1974).

References

Berry, E.M., Hirsch, J., Most, J., & Thornton, J. (1986). The role of dietary fat in human obesity. International Journal of Obesity, 10:123-131.

Braitman, L.E., Adlin, E.V., & Stanton, J.L. (1985). Obesity and caloric intake: the National Health and Nutrition Examination Survey of 1971-1975 (HANES I). Journal of Chronic Disease, 38(9):727-732.

Bray, G.A. (1987). Overweight is risking fate. Annals of the New York Academy of Science 499:14-28.

Brownell, K.D. (1982). Obesity: understanding and treating a serious, prevalent, and refractory disorder. Journal of Consulting and Clinical Psychology, 50(6):820-840.

Conway, T.L., Trent, L.K., & Conway, S.W. (1989). Physical readiness and lifestyle habits among U.S. Navy personnel during 1986, 1987, and 1988 (Report No. 89-24). San Diego: Naval Health Research Center.

Davidson, S., Passmore, R., Brock, J.F. & Truswell, A.S. (1979). Human nutrition and dietetics. Edinburgh, Scotland: Churchill Livingstone, Longman Group.

Department of the Navy (1986). Physical Readiness Program (OPNAV Instruction 6110.1C). Washington, DC: Office of the Chief of Naval Operations.

Drewnowski, A. (1985). Food perceptions and preferences of obese adults: a multidimensional approach. International Journal of Obesity, 9:201-212.

Dutton, L.J. & Conway, T.L. (1987). Dietary factors related to physical fitness (Report No. 87-28). San Diego: Naval Health Research Center.

Food and Nutrition Board (1974). Recommended dietary allowances. Washington, DC: National Research Council, National Academy of Sciences.

Garrow, J.S. (1987). Energy balance in man--an overview. American Journal of Clinical Nutrition, 45:1114-1119.

Gonzalez, E.R. (1983). Studies show the obese may prefer fats to sweets. Journal of the American Medical Association, 250(5):579.

Greenwood, M.R.C. and Pittman-Waller, V. (1988). Weight control: a complex, various, and controversial problem. In R.T. Frankle & M. Yang (Eds.), Obesity and weight control: the health professional's guide to understanding and treatment (pp. 3-15). Rockville, MD: Aspen Publishers, Inc.

Harper, A.E. (1987). Transitions in health status: implications for dietary recommendations. American Journal of Clinical Nutrition, 45:1094-1107.

Hashim, S.A. & Van Itallie, T.B. (1965). Studies in normal and obese subjects with a monitored food dispensing device. Annals of the New York Academy of Science, 131:654-661.

Hodgdon, J.A. & Beckett, M.B. (1984a). Prediction of percent body fat for U.S. Navy men from body circumferences and height (Report No. 84-11). San Diego: Naval Health Research Center.

Hodgdon, J.A. & Beckett, M.B. (1984b). Prediction of percent body fat for U.S. Navy women from body circumferences and height (Report No. 84-29). San Diego: Naval Health Research Center.

Hoiberg, A., Berard, S.P., & Watten, R.H. (1978). Correlates of obesity (Report No. 78-50). San Diego: Naval Health Research Center.

Howard, R.B. & Herbold N.H. (1978). Nutrition in clinical care. New York: McGraw-Hill.

Johnson, C. Tobin, D. & Enright, A. (1989). Prevalence and clinical characteristics of borderline patients in an eating disordered population. Journal of Clinical Psychiatry, 50(1):9-15.

Kannel, W.B. & Gordon, T. (1979). Physiological and medical concomitants of obesity: the Framingham study. In G.A. Bray (Ed.), Obesity in America (DHEW Pub. No. (NIH) 79-359)(pp. 125-163). Washington, DC: U.S. Government Printing Office.

Katzeff, H.L. (1988). Energy metabolism and thermogenesis in obesity. In R.T. Frankle & M. Yang (Eds.), Obesity and weight control: the health professional's guide to understanding and treatment (pp. 55-70). Rockville, MD: Aspen Publishers, Inc.

Keck, J.N. & Fiebert, M.S. (1986). Avoidance of anxiety and eating disorders. Psychological Reports, 58:432-434.

Kolotkin, R.L., Revis, E.S., Kirkley, B.G. & Janick, L. (1987). Binge eating in obesity: associated MMPI characteristics. Journal of Consulting and Clinical Psychology, 55(6):872-876.

Leads from the Morbidity and Mortality Weekly Report (1988). Prevalence of overweight in selected states--behavioral risk factor surveillance, 1986. Journal of the American Medical Association, 259(6):797-798.

Leon, G.R. & Roth, L. (1977). Obesity: psychological causes, correlations, and speculations. Psychological Bulletin, 84(1):117-139.

Lincoln, J.E. (1972). Calorie intake, obesity, and physical activity. American Journal of Clinical Nutrition, 25:390-394.

Loro, A.D. & Orleans, C.S. (1981). Binge eating in obesity: preliminary findings and guidelines for behavioral analysis and treatment. Addictive Behaviors, 5:155-166.

Lowe, M.R. & Fisher, E.B. (1983). Emotional reactivity, emotional eating, and obesity: a naturalistic study. Journal of Behavioral Medicine, 6(2):135-149.

Mann, G.V. (1974). The influence of obesity on health. New England Journal of Medicine, 291:178-185.

McArdle, W.D., Katch, F.I., & Katch, V.L. (1986). Exercise physiology: energy, nutrition, and human performance. Philadelphia: Lea & Febiger. pp. 642-649.

McArdle W.D. & Toner, M.M. (1988). Application of exercise for weight control: the exercise prescription. In R.T. Frankle & M. Yang (Eds.), Obesity and weight control: the health professional's guide to understanding and treatment (pp. 257-274). Rockville, MD: Aspen Publishers, Inc.

Najjar, M.F. & Rowland, M. (1987). Anthropometric reference data and prevalence of overweight—United States, 1976-80 (DHHS Pub. No. 87-1688, Vital and Health Statistics series 11, No. 238). Hyattsville, MD: U.S. Department of Health and Human Services, U.S. Public Health Service.

National Center for Health Statistics (1983). Obese and overweight adults in the United States (DHHS Pub. No. 83-1680, Vital and Health Statistics series 11, No. 230). Washington, DC: U.S. Public Health Service.

Nice, D.S. & Conway, T.L. (1988). Exercise patterns in the U.S. Navy (Report No. 88-1). San Diego: Naval Health Research Center.

Pacy, P.J., Webster, J., & Garrow, J.S. (1986). Exercise and obesity. Sports Medicine, 3:89-113.

Pennington, J.A.T. & Church, H.N. (1985). Food values of portions commonly used. San Francisco: Harper & Row.

Pi-Sunyer, F.X. (1988). Exercise in the treatment of obesity. In R.T. Frankle & M. Yang (Eds.), Obesity and weight control: the health professional's guide to understanding and treatment (pp. 241-255). Rockville, MD: Aspen Publishers, Inc.

Raymond, C.A. (1988). Do obese persons mirror thin counterparts in calorie intake, recall of food consumed? Journal of the American Medical Association, 260(3):314.

Schoenborn C.A. (1986). Health habits of the U.S. adults: "Alameda 7" revisited. Public Health Reports, 101:571-580.

Simopoulos, A.P. (1986). Obesity and body weight standards. Annual Review of Public Health, 7:481-492.

Stephenson, M.G., Levy, A.S., Sass, N.L., & McGarvey, W.E. (1987). 1985 NHIS findings: nutrition knowledge and baseline data for the weight-loss objectives. Public Health Reports, 102:61-67.

Stuart, R.B. (1980). Weight loss and beyond: are they taking it off and keeping it off? In P.O. Davidson & S.M. Davidson (Eds.), Behavioral medicine: changing health lifestyles (pp. 151-194). New York: Brunner/ Mazel.

Stunkard, A.J. & Burt, V. (1967). Obesity and the Body Image. Part 2. Age at onset of the disturbances in body image. American Journal of Psychiatry, 123:1443-1447.

Thompson, J.K., Jarvie, G.J., & Lahey, B.B. (1982). Exercise and obesity: etiology, physiology, and intervention. Psychological Bulletin, 91(1): 55-79.

Trent, L.K. & Conway, T.L. (1988). Dietary factors related to physical fitness among Navy shipboard men. American Journal of Health Promotion, 3(2):12-24.

U.S. Departments of Health and Human Services and Agriculture (1986). Nutrition monitoring in the United States (DHHS Pub. No. [PHS] 86-1255). Washington, D.C.: U.S. Government Printing Office.

U.S. Public Health Service (1988). The surgeon general's report on nutrition and health (DHHS Pub. No. 88-50210). Washington, DC: U.S. Department of Health & Human Services.

Van Itallie, T.B. (1985). Health implications of overweight and obesity in the United States. Annals of Internal Medicine, 103(6,2):983-988.

Van Itallie, T.B. (1979). Obesity: adverse effects on health and longevity. American Journal of Clinical Nutrition, 32:2723-2733.

Williamson, D.A., Kelley, M.L., Davis, C.J., Ruggiero, L., & Blouin, D.C. (1985). Psychopathology of eating disorders: a controlled comparison of bulimic obese, and normal subjects. Journal of Consulting and Clinical Psychology, 53(2):161-166.

Wilson, G.T. (1976). Obesity, binge eating, and behavior therapy: some clinical observations. Behavior Therapy, 7:700-701.

Wright, E.J. & Whitehead, T.L. (1987). Perceptions of body size and obesity: a selected review of the literature. Journal of Community Health, 12(2,3): 117-129.

UNCLASSIFIED

SECURITY CLASSIFICATION OF THIS PAGE

REPORT DOCUMENTATION PAGE

1a. REPORT SECURITY CLASSIFICATION Unclassified	1b RESTRICTIVE MARKINGS N/A
2a SECURITY CLASSIFICATION AUTHORITY N/A	3 DISTRIBUTION/AVAILABILITY OF REPORT Approved for public release; distribution unlimited.
2b DECLASSIFICATION/DOWNGRADING SCHEDULE N/A	
4. PERFORMING ORGANIZATION REPORT NUMBER(S) NHRC Report No. 89-56	5 MONITORING ORGANIZATION REPORT NUMBER(S)
6a NAME OF PERFORMING ORGANIZATION Naval Health Research Center 6b OFFICE SYMBOL (If applicable) 40	7a NAME OF MONITORING ORGANIZATION Chief Bureau of Medicine and Surgery
6c. ADDRESS (City, State, and ZIP Code) P.O. Box 85122 San Diego, CA 92138-9174	7b. ADDRESS (City, State, and ZIP Code) Department of the Navy Washington, DC 20372
8a. NAME OF FUNDING/SPONSORING ORGANIZATION Naval Medical Research & Development Com and 8b OFFICE SYMBOL (If applicable)	9 PROCUREMENT INSTRUMENT IDENTIFICATION NUMBER Naval Military Personnel Command Reimbursable Doc. No. N0002289WRWW542
8c. ADDRESS (City, State, and ZIP Code) NMC NCR Bethesda, MD 20814-5044	10 SOURCE OF FUNDING NUMBERS PROGRAM ELEMENT NO / PROJECT NO / TASK NO / WORK UNIT ACCESSION NO.

11 TITLE (Include Security Classification)

(U) DIETARY AND BEHAVIORAL PREDICTION OF OBESITY IN THE NAVY

12 PERSONAL AUTHOR(S)

Barbara C. Du Bois, Jerry D. Goodman, and Terry L. Conway

13a TYPE OF REPORT	13b TIME COVERED	14 DATE OF REPORT (Year, Month, Day)	15 PAGE COUNT
Interim	FROM _____ TO _____	1989 Dec 28	

16. SUPPLEMENTARY NOTATION

17 COSATI CODES		
FIELD	GROUP	SUB-GROUP

18 SUBJECT TERMS (Continue on reverse if necessary and identify by block number)

Diet, Navy Men and Women, Food, Nutrition, Dietary Behavior, Psychology, Obesity, Exercise

19. ABSTRACT (Continue on reverse if necessary and identify by block number)

This study examined the relationships between obesity, dietary intake, and health and food-related behaviors. The sample (N=153) consisted of lean and overweight Navy men and women. Dietary findings indicated that overweight males consumed significantly fewer calories and less carbohydrate than lean males; however, non-significant trends showed that overfat males consumed more cholesterol and sucrose than normal weight males. Overfat females ate significantly more fat, cholesterol, saturated fat, and sodium than normal weight females. For the sample as a whole, carbohydrate intake was negatively related to percent body fat, such that those with higher percent fat were less likely to eat carbohydrates than those of normal weight. Overweight participants, especially those who were older, were more likely to have food obsessions and engage in emotional eating. Navy weight reduction treatment programs might target specific eating behaviors to increase carbohydrate and decrease fat in the diets of overweight personnel; additionally, psychological counseling for emotional/obsessional eating behaviors is warranted.

20 DISTRIBUTION/AVAILABILITY OF ABSTRACT	21 ABSTRACT SECURITY CLASSIFICATION
☐ UNCLASSIFIED/UNLIMITED ☒ SAME AS RPT ☐ DTIC USERS	Unclassified
22a NAME OF RESPONSIBLE INDIVIDUAL Terry L. Conway	22b TELEPHONE (Include Area Code) (619) 553- 8465 / 22c. OFFICE SYMBOL 40

DD FORM 1473, 84 MAR 83 APR edition may be used until exhausted. All other editions are obsolete

Unclassified

☆U.S. Government Printing Office: 1985-607-647